

APRIL/MAY 2023

DPH31 — CONDENSED MATTER PHYSICS

Time : Three hours

Maximum : 75 marks



SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Give some examples of inert gas crystals.
2. Find the Miller indices of a plane, which makes intercepts at $3a$, $2b$, and $2c$.
3. Give an evidence for the existence of phonons.
4. What is meant by phase velocity?
5. List out the drawbacks of Wiedemann–Franz law.
6. The Hall coefficient of a specimen is found to be $3.66 \times 10^{-4} \text{ m}^3/\text{C}$. The resistivity of the specimen is $8.93 \times 10^{-3} \Omega\text{m}$. Find the density of the charge carriers.
7. State Hund's rule.
8. What is meant by orbital angular momentum?
9. What is meant by Cooper pair?
10. Define Meissner effect.

SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL questions.

11. (a) Prove that the reciprocal lattice of a BCC lattice is FCC lattice.

Or

- (b) Derive the general expression for the atomic form factor.

12. (a) Discuss the limitations of Debye's model of specific heat.

Or

- (b) Write a note on Quantization of lattice vibrations.

13. (a) Discuss the free electron gas in three dimension.

Or

- (b) State and prove Bloch theorem.

14. (a) Describe in detail about the quantum theory of paramagnetism.

Or

- (b) Write a short note on magnons.

15. (a) How do the thermodynamic properties of superconductors differ from normal conductors.

Or

- (b) Derive London equations.

SECTION C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

16. Describe Laue's equation to obtain the diffraction condition.

17. Discuss in detail about Einstein's model of specific heat.

18. Discuss the formation of allowed forbidden energy bands on the basis of Kronig Penny model.

19. Describe in detail about the Heisenberg's interpretation of Weiss field. How does it explain the concept of ferromagnetism?

20. Write short notes on

(a) Isotopic effect (b) SQUID

(c) Type I and Type II Super conductors.